Making power transmission shafts

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Abstract of **GB2028691**

A method of forming a power- take-off or drive shaft includes the steps of providing a shaft (10) with a power- take-off end (10A) having a diameter uniform with the diameter of a greater portion (13) of the shaft (10), heat- treating said end (10A) and end (10C) to between 50 and 54 on the Rockwell C scale and grinding the surface of the shaft (10) to remove any imperfections and circumferential lines there around. The power-take-off end is provided with nineteen splines (11) and consequently twenty serrations (12) between the splines (11).

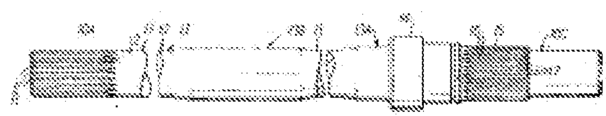

Fig.1

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(54) **Making power transmission shafts**

(57) A method of forming a power-take-off or drive shaft includes the steps of providing a shaft (10) with a power-take-off end (10A) having a diameter uniform with the diameter of a greater portion (13) of the shaft (10), heat-treating said end (10A) and end (10C) to between 50 and 54 on the Rockwell C scale and grinding the surface of the shaft (10) to remove any imperfections and circumferential lines there around. The power-take-off end is provided with nineteen splines (11) and consequently twenty serrations (12) between the splines (11).

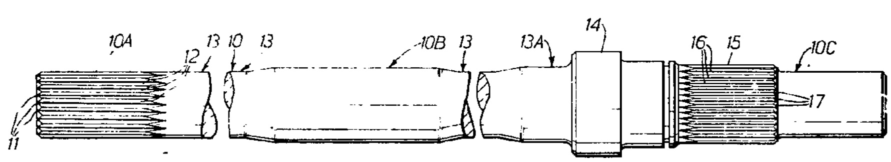

Fig. 1

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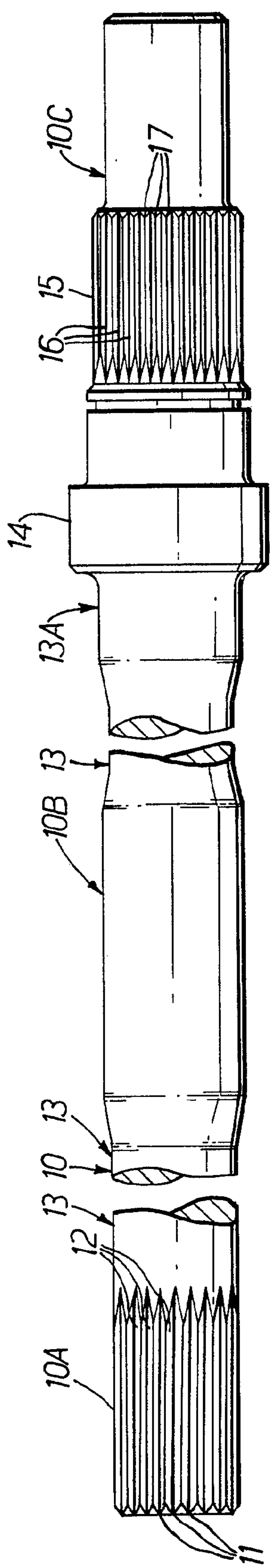
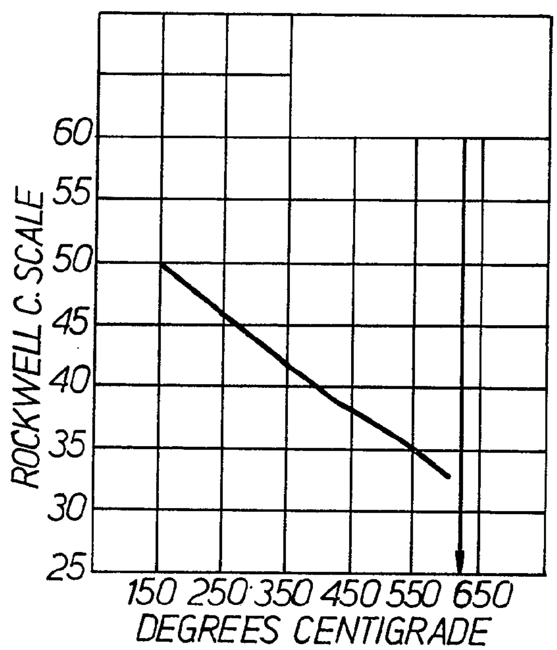


Fig.1



ROCKWELL C. SCALE
60
55
50
45
40
35
30
25
150 250 350 450 550 650
DEGREES CENTIGRADE

Fig. 2

SPECIFICATION

Transmission shafts

This invention relates to a method of forming power transmission shafts, namely power-take-off or drive shafts for agricultural tractors or like traction units having power-take-off facility.

Power-take-off or drive shafts have been formed heretofore of CARRS P 564 Nickel chrome tool steel which has the characteristic of having a high resistance to torsional stress and fatigue, and which consists of carbon, manganese, nickel and chromium in the respective approximate proportions .30%, .60%, 3.00% and 0.75%, the balance being iron with impurities and incidental ingredients.

The heat treatment for such steel includes the steps of forging the shaft from one piece of steel in a furance at a commencing temperature of 1150°C and reheating as necessary to avoid working below a temperature of 900°C, annealing the shaft so forged by soaking for at least 2 hours per inch of thickness at a temperature of 650°C and cooling in still air, stress relieving by heating the shaft uniformly to a temperature of 600/630°C and allowing to equalise before removing from the furnace then cooling in still air to room temperature, and hardening by thoroughly warming the shaft before charging which is by heating and soaking in accordance with either of the two following procedures (a) and (b):-

(a) *Salt Bath Procedure*

Charge the shaft into a pre-heater chamber at a temperature of 300/400°C and soaking thoroughly up to 1 hour per inch of ruling section, and thereafter remove to neutral salt bath operating at a temperature of 820/840°C and maintain for 20 minutes at that temperature, or for 10 minutes per inch of ruling section (whichever is the greater).

(b) *Open Furnace Procedure*

Charge the shaft into a muffle furnace working at a temperature of 300/400°C and soak thoroughly for up to 1 hour per inch of ruling section.

Thereafter, raise the heat uniformly to a temperature of 820/840°C and maintain at this temperature for sufficient time to allow the shaft to equalise, the shaft being soaked for a few minutes only when this point is reached. Then quench the shaft in oil, and thereafter temper same immediately to the desired requirements whilst the shaft is still hand warm, soak the shaft at the required temperature for 1 hour per inch of ruling section, and then cool the shaft in still air. Tempering is accomplished according to a tempering graph as shown in drawings accompanying this specification, the curve of the graph being based on tests carried out as follows:-

Size of test piece	-	1⅛ inch (28.5 mm) diameter
Hardening temperature	-	830°C
Type of quench	-	oil

The entire shafts are normally heat treated to 35 on the Rockwell C scale - 55/65 t.t. for medium tensile strength and at a temperature of 450/600°C.

Both the end to be coupled to the power-take-off and the end for connection to the attachment for which power is required of each shaft are splined, and the shaft is of a predetermined profile along its length. Such shafts will hereinafter be referred to as "a shaft of the type aforesaid".

It has been found that when shafts of the type aforesaid are used with a tractor or traction unit having a 90-120 horse power engine and therefore a high power-take-off speed, and with a heavy load at the outer end of the shafts, they tend to shatter or break after a short period of use, and this is a severe disadvantage, particularly with the increase in demand for higher powered tractors for use with attachments capable of a greater work load output per man hour than heretofore especially but not exclusively for agricultural contract work. Research into obviating or mitigating this disadvantage has to date proved unsuccessful.

It is an object of the present invention to obviate or mitigate the above disadvantage.

According to the present invention, there is provided a method of forming a power-take-off or drive shaft including the steps of providing the power-take-off end of a shaft of the type aforesaid with a diameter uniform with the diameter of a greater portion of the shaft, heat-treating said end to between 50 and 54 on the Rockwell C scale, and thereafter grinding the surface of said shaft to remove any imperfections and/or circumferential lines therearound.

Preferably, the method includes heat treating the opposite end of the shaft to between 50 and 54 on the Rockwell C scale.

Preferably also, the method includes the step of providing a smooth profile at least over the greater length of the shaft extending from the power-take-off end.

Preferably further, the method includes providing the power-take-off end with nineteen splines and consequently twenty serrations between the splines.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a side elevational view of a shaft according to the present invention and;

Figure 2 is a tempering graph.

Referring to Figure 1, a power-take-off or drive shaft 10 is formed by providing the power-take-off end 10A of a shaft of the type aforesaid with a diameter uniform with the diameter of the greater portion 13 of the shaft 10 and heat-treating said end 10A to between 50 and 54 on the Rockwell C Scale. The surface of the shaft 10 so formed is ground to remove any imperfections and/or circumferential lines therearound. The shaft 10 is also provided with a smooth profile, i.e., without any circumferential steps in its profile over the greater length of the shaft 10 extending from the power-take-off end 10A, and an increase in the diameter of the shaft provided at 10B in said greater portion 13 is gradual.

The power-take-off end 10A is provided with nineteen splines 11 and consequently twenty serrations 12 between the splines 11 to give good keying with the complementary part of the power-take-off coupling and therefore to give positive transference of power.

The end 13A of the greater portion 13 remote from end 10A of the shaft 10 is increased in diameter to the same as the increased diameter of 10B. The profile of the remainder of the shaft 10 is the same as for shafts provided heretobefore and from the end 13A has in spaced succession towards end 10C of the shaft 10, a shoulder 14 and a splined portion 15 having twenty-four splines 16 and consequently 25 serrations 17. The end 10C of the shaft and the splined portion 15 are heat-treated in the same manner as end 10A. Each serration 12 and 17 has a 90° tooth form.

In an example, a shaft 10 as above-described is $39^{15}/16$ inches (1,014 mm) in axial length and has a diameter of 1.048 inches (26.62 mm) which is also the outside diameter of the power-take-off end 10A. The depth of the serrations is approximately .047 inches (1.19 mm). The greater portion, including end 10A, is 35 inches (889 mm) in axial length and the increase in diameter of the shaft 10 to 1.191 inches (30.25 mm) commences 20½ inches (520.70 mm) axially along from the power-take-off end 10A and is itself 2½ inches (63.50 mm) in axial length. The end 13A is of ¾ inch (19.05 mm) in axial length and of 1.048 inches (26.62 mm) diameter. The shoulder 14 is ¾ inches (19.05 mm) axial length at diameter 1.687 inches (42.85 mm) with a portion of shaft 10 of .64 inches (16.256 mm) axial length and diameter 1.3783 inches (35.01 mm). The splined portion 15 is 1.646 inches (41.81 mm) axial length and outside diameter 1.2905 inches (32.77 mm). The end 10C is of axial length 1.7965 inches (45.63 mm) and diameter 1.0625 inches (26.98 mm).

A shaft as above described is used in a known manner as a power-take-off or drive shaft.

CLAIMS

1. Method of forming a power-take-off or drive shaft including the steps of providing the power-take-off end of a shaft of the type aforesaid with a diameter uniform with the diameter of a greater portion of the shaft, heat-treating said end to between 50 and 54 on the Rockwell C scale, and thereafter grinding the surface of said shaft to remove any imperfections and/or circumferential lines therearound.
2. A method as claimed in Claim 1, wherein preferably, the method includes heat treating the opposite end of the shaft to between 50 and 54 on the Rockwell C scale.
3. A method as claimed in Claim 1 or 2, wherein the method includes the step of providing a smooth profile at least over the greater length of the shaft extending from the power-take-off end.
4. A method as claimed in Claim 1, 2 or 3, wherein the method includes providing the power-take-off end with nineteen splines and consequently twenty serrations between the splines.
5. A method substantially as hereinbefore described with reference to the accompanying drawings.
6. A shaft substantially as hereinbefore described with reference to the accompanying drawings.

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